Applicant : Ke Han et al.
Serial No. : 10/799,543
Filed : March 11, 2004
Page : 9 of 17

Attorney's Docket No.: MP0413 / 13361-0072001

REMARKS

Claims 1, 4-7, 10-14, 16, 17, 20, 21, 23, 24, and 26 are pending, with claims 1, 7, 13, 17,

21, and 24 being independent. Reconsideration and allowance of the above-referenced

application are respectfully requested.

Rejections under 35 U.S.C. 102 & 103

Claims 13 and 14 stand rejected under 35 U.S.C. 102(b) as allegedly being anticipated by

Cideciyan et al. (U.S. Patent No. 6,377,635). Claim 16 stands rejected under 35 U.S.C. 103 as

allegedly being anticipated by Cideciyan in view of McEwen et al. (U.S. Patent No. 6,366,418).

These contentions are respectfully traversed.

Independent claim 13 recites "a branch metric generator that generates branch metrics

comprising a cross-correlation of obtained output sequences and estimated output sequences for

a partial response channel; an add-compare-select component that compares paths and

determines survivor paths using generated branch metrics; a memory that retains metrics

information; and a trace-back component that determines a best path of the survivor paths and

outputs sequence information based on the determined best path; wherein the partial response

channel has a transfer function defined according to a target polynomial,

$T(D) = p_0 + p_1 D + \cdots + p_M D^M$, the branch metric generator operates according to a trellis

having 2^M states, and all the survivor paths merge in M steps."[1] The Office cites to equations 3

and 4 of Cideciyan as allegedly teaching the claimed branch metric generator that generates

branch metrics comprising a cross-correlation of obtained output sequences and estimated output

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[1] Emphasis added.

Applicant : Ke Han et al.   Attorney's Docket No.: MP0413 / 13361-0072001
Serial No. : 10/799,543
Filed : March 11, 2004
Page : 10 of 17

sequences for a partial response channel. The Office further states, "The Metric in equation 3 or 4 includes a crosscorrelation term and a constant term. The cross-correlation term is referred to as the <u>data-dependent</u> or time varying term."[2]

However, Cideciyan <u>does not teach</u> a branch metric generator that generates branch metrics comprising this cross-correlation term, which is referred to as the data-dependent or time varying term. In fact, Cideciyan explicitly states the opposite:[3]

> In accordance with features of the invention, the branch metrics are transformed so that some of the constant terms and all of the data dependent or time-varying terms are shifted after the add/compare/select (ACS) unit and added directly to the state metrics. [...] the branch metrics themselves become constants.

Thus, independent claim 13 does not read on Cideciyan.

Cideciyan <u>does not teach</u> using the claimed cross-correlation in the branch metrics <u>generated by a branch metric generator</u>, which branch metrics are then used by an add-compare-select component to determine survivor paths, as presently claimed. This fact is not refuted by the Office's noting that:[4]

> Figures 3-13, shows the trellis performing ACS (Add-Compare-Select) operations to find the updated state metrics by using branch metric data dependent terms. Therefore, Cideciyan teaches of the branch metrics used by an add-compare-select component to determine survivor paths.

It is clear from Cideciyan's description that the branch metrics used by <u>an add-compare-select component</u> <u>are not the same</u> as branch metrics used by <u>a branch metric generator</u>. In fact,

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[2] *See* 09-08-2009 Office Action at page 10.
[3] *See* Cideciyan at col. 3, lines 34-43.
[4] *See* 09-08-2009 Office Action at page 10.

Applicant : Ke Han et al.
Serial No. : 10/799,543
Filed : March 11, 2004
Page : 11 of 17

Attorney's Docket No.: MP0413 / 13361-0072001

Cideciyan explicitly states in multiple places that his transformed metric shifts the channel output dependent term of the branch metric "after the ACS units <u>leaving on the trellis branches only constants</u>."[5]

For at least the above reasons, independent claim 13 should be in condition for allowance. Since McEwen fails to cure the deficiencies of Cideciyan, each of dependent claims 14 and 16 should be allowable based on at least the above arguments.

Rejection under 35 U.S.C. 103

Claims 1, 4-7, 10-12, 17, 20, 21, 23, 24, and 26 stand rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Cideciyan et al. (U.S. Patent No. 6,377,635) in view of Fisher et al. (U.S. Patent No. 6,249,398). This contention is respectfully traversed.

Independent claim 1 recites, "obtaining an output signal sequence from a partial response channel, the output signal sequence comprising a waveform of widely varying amplitude; determining an input sequence of the partial response channel <u>by maximizing cross-correlation</u> of an estimated output sequence with the obtained output sequence, the estimated output sequence being estimated based on the partial response channel; and providing an output corresponding to the determined input sequence; wherein said determining the input sequence comprises employing Viterbi detection using a cross-correlation branch metric, the Viterbi detection providing a robust tolerance of phase uncertainty with the waveform of widely varying amplitude including providing accurate detection decisions even when the amplitude of the waveform is very small; and wherein the partial response channel has a transfer function defined

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[5] *See* Cideciyan at col. 4, lines 28-31, and lines 58-62 (emphasis added).

according to a target polynomial, $T(D) = p_0 + p_1 D + \cdots + p_M D^M$, the Viterbi detection operates

according to a trellis having 2^M states, and all survivor paths associated with all the 2^M states in

the trellis merge in M steps."[6] As noted above, Cideciyan does employ a cross-correlation of an

estimated output sequence with an obtained output sequence in the process of designing a Viterbi

detection method and apparatus. However, Cideciyan does not describe <u>determining an input</u>

<u>sequence</u> of the partial response channel <u>by maximizing cross-correlation</u> of an estimated output

sequence with the obtained output sequence.

In response to this point, the Office now makes the following argument in the Final

Office Action:[7]

> Cideciyan teaches of minimizing the metric of equation 3. Since the data
>
> dependent term is negative, it would be required to maximize the cross-correlation in
>
> order to minimize the metric.

However, minimizing the metric of equation 3 in Cideciyan <u>is not equivalent</u> to <u>determining an</u>

<u>input sequence</u> of the partial response channel <u>by</u> <u>maximizing cross-correlation</u> of an estimated

output sequence with the obtained output sequence, as recited in the claim, because Cideciyan is

<u>still determining the constants</u>.

While limitations from the Specification may not be read into the claims, the claim

language must be read "in light of the specification as it would be interpreted by one of ordinary

skill in the art."[8] As described in the Specification:[9]

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[6] Emphasis added.
[7] *See* 09-08-2009 Office Action at page 10.
[8] *See* MPEP 2111.
[9] See Specification at ¶ 24-26 (emphasis added).

Applicant : Ke Han et al.
Serial No. : 10/799,543
Filed : March 11, 2004
Page : 13 of 17

Attorney's Docket No.: MP0413 / 13361-0072001

When there is uncertainty about the gain of the partial response channel, then a gain factor can be introduced in the target partial response, and the target partial response can be written as $P' = \begin{bmatrix} \alpha p_0 & \alpha p_1 & \cdots & \alpha p_M \end{bmatrix}$. This equation assumes that the function only changes in the amplitude; the relative scaling of the different terms remains the same. The traditional Viterbi decision sequence should then be the estimated input sequence $\hat{B}' = \begin{bmatrix} \hat{b}'_0 & \hat{b}'_1 & \cdots & \hat{b}'_N \end{bmatrix}$, which minimizes the quantity,

$$(1) \quad \sum_{k=0}^{N} \left(y_k - \hat{y}'_k \right)^2,$$

where $\hat{y}'_k = \sum_{i=0}^{M} \hat{b}'_{k-i} \cdot \alpha \cdot p_i = \alpha \cdot \sum_{i=0}^{M} \hat{b}'_{k-i} \cdot p_i = \alpha \cdot y_k^*$, and $y_k^* = \sum_{i=0}^{M} \hat{b}'_{k-i} \cdot p_i$. The quantity in equation (1) can be re-written as,

$$(2) \quad \sum_{k=0}^{N} \left(y_k - \hat{y}'_k \right)^2 = \sum_{k=0}^{N} \left(y_k - \alpha \cdot y_k^* \right)^2 = \sum_{k=0}^{N} y_k^2 + \alpha^2 \cdot \sum_{k=0}^{N} \left(y_k^* \right)^2 - 2\alpha \sum_{k=0}^{N} y_k \cdot y_k^*.$$

The three terms on the right side of equation (2) can be understood as the summation of the square of the real output of the channel, the summation of the square of the estimated channel output scaled by the channel gain factor, and the cross-correlation of the real channel output and the estimated channel output scaled by the channel gain factor. Since $\sum_{k=0}^{N} y_k^2$ is not a function of the choice of $\hat{B}$ (the estimated input sequence), minimizing the quantity in equation (2) over B' is equivalent to minimizing

$$(3) \quad \alpha^2 \cdot \sum_{k=0}^{N} \left(y_k^* \right)^2 - 2\alpha \sum_{k=0}^{N} y_k \cdot y_k^*$$

or, since α is not a function of the estimated input,

$$(4) \quad \alpha \cdot \sum_{k=0}^{N} \left(y_k^* \right)^2 - 2 \sum_{k=0}^{N} y_k \cdot y_k^*.$$

Applicant : Ke Han et al.
Serial No. : 10/799,543
Filed : March 11, 2004
Page : 14 of 17

Attorney's Docket No.: MP0413 / 13361-0072001

When α is small, the first term in equation (4) <u>can be ignored</u>, and the Viterbi algorithm can be used to <u>minimize the second term</u> (i.e., <u>maximize the correlation</u>, as the second term is negative in equation (4)). When the noise power is not changing with the amplitude of the signal and the signal amplitude is very small, maximizing the second term is essentially the same as minimizing the whole quantity, providing close to optimal performance.

When the signal amplitude is very large, the first term in equation (4) <u>is still ignored</u>, resulting in less than optimal performance as compared with traditional Viterbi in terms of error probability. But because the signal to noise ratio (SNR) is higher with larger amplitudes of the signal, <u>good results can still be obtained</u>. By maximizing the correlation between the sampled sequence and the recovered sequence, received sequences can be accurately interpreted, even when the signal carrying the sequences has a widely varying amplitude. A signal processing apparatus using these techniques can be biased to the worst case, guaranteeing the performance of the worst case scenario.

Thus, when read in light of the specification, the plain meaning of <u>determining an input sequence</u> of the partial response channel <u>by</u> <u>maximizing cross-correlation</u> of an estimated output sequence with the obtained output sequence, as recited in the claim, is that the <u>constant terms are ignored</u>. Cideciyan never suggests such subject matter, as claimed.

Furthermore, the Office's <u>bare citation</u> to Figs. 8-14 of Cideciyan[10] fails to support the contention that Cideciyan teaches that "all the survivor paths merge in M steps", as recited in the claim. Thus, there is a clear legal or factual deficiency in the current rejection for at least this reason.

Independent claims 7 and 17 recite similar language as found in claim 1, and Fisher fails to cure the deficiencies of Cideciyan. Thus, for at least the above reasons, each of independent

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[10] *See* 09-08-2009 Office Action at page 5.

Applicant : Ke Han et al.
Serial No. : 10/799,543
Filed : March 11, 2004
Page : 15 of 17

Attorney's Docket No.: MP0413 / 13361-0072001

claims 1, 7 and 17 should be in condition for allowance. Dependent claims 4-6, 10-12, and 20 should be allowable based on at least the above arguments.

Independent claim 21 recites, "an input line that provides a sampled channel sequence; and Viterbi detection means for determining a recovered sequence from the sampled channel sequence, the Viterbi detection means including means for maximizing cross-correlation of the recovered sequence and the sampled channel sequence; wherein the sampled channel sequence comprises a waveform of widely varying amplitude, and the Viterbi detection means provides robust tolerance of phase uncertainty with the waveform of widely varying amplitude including providing accurate detection decisions even when the amplitude of the waveform is very small."[11] The arguments presented above regarding maximizing cross-correlation are applicable to claim 21 as well. In addition, note that claim 21 uses "means for" language and that:[12]

> Where means plus function language is used to define the characteristics of a machine or manufacture invention, such language must be interpreted to read on only the structures or materials disclosed in the specification and "equivalents thereof" that correspond to the recited function. Two *en banc* decisions of the Federal Circuit have made clear that the USPTO is to interpret means plus function language according to 35 U.S.C. § 112, sixth paragraph.

In the present case, the Office has failed to comply with this legal requirement, making no effort to identify how the claim language has been interpreted to read on only the structures disclosed in the specification or equivalents thereof. Thus, there is a clear legal or factual deficiency in the rejection of claim 21 for at least this reason.

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[11] Emphasis added.
[12] *See* MPEP § 2106(II)(C) (emphasis added).

Applicant : Ke Han et al.
Serial No. : 10/799,543
Filed : March 11, 2004
Page : 16 of 17

Attorney's Docket No.: MP0413 / 13361-0072001

Moreover, as noted in the last Response, Fisher uses an error generator 64 to provide input via a path 67 to timing control circuitry 70, which in turn adjusts the sampling phase of the sampler 46. However, components 64, 67, 70 and 46 are clearly separate from the Viterbi detector 60.[13] Thus, these components cannot be equated with the claimed subject matter, where "the Viterbi detection means provides robust tolerance of phase uncertainty."[14] In response to this point, the Office states:[15]

> Examiner submits that Fisher discloses of a timing recovery unit to provide a robust tolerance of phase uncertainty to the signal inputted in the Viterbi detector from the loop as shown in Figure 2. Eventhough, the error generator is outside the Viterbi Detector, the error generator is coupled to the Viterbi Detector and the robust tolerance of phase uncertainty performed by the Timing Control is based on both the input and output of the Viterbi detector (output of the error generator).

Thus the Office admits that Fisher describes processing done to the signal provided to the Viterbi detector 60, where this signal processing is done by components outside the Viterbi detector 60, not signal processing performed by the Viterbi detector 60. These are significant structural differences. Since the claim uses "means for" language, the Office is not free to disregard structural differences between the claimed subject matter and the cited art.[16] Thus, there is a clear legal or factual deficiency in the rejection of claim 21 for at least this additional reason.

For at least the above reasons, claim 21 should be allowable. Independent claim 24 recites similar language as found in claim 21. Thus, for at least the above reasons, independent

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[13] *See* Fisher at FIG. 2.
[14] Emphasis added.
[15] *See* 09-08-2009 Office Action at page 11.
[16] *See* MPEP § 2106(II)(C).

Applicant : Ke Han et al.
Serial No. : 10/799,543
Filed : March 11, 2004
Page : 17 of 17

Attorney's Docket No.: MP0413 / 13361-0072001

claim 24 should also be in condition for allowance. Dependent claims 23 and 26 should be allowable based on at least the above arguments.
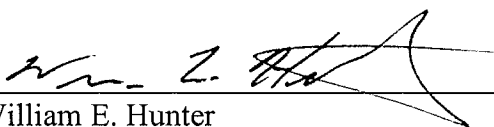
CONCLUSION

The foregoing comments made with respect to the positions taken by the Office are not to be construed as acquiescence with other positions of the Office that have not been explicitly contested. Accordingly, the above arguments for patentability of a claim should not be construed as implying that there are not other valid reasons for patentability of that claim or other claims.

In view of the present response, all of the claims should be in condition for allowance. A formal notice of allowance is respectfully requested.

Please apply any necessary charges or credits, to deposit account 06-1050.

Respectfully submitted,

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